mium. This, together with other experience along similar lines, convinced the speaker that the best single inspection possible will not remove all infected trees from a diseased lot. There will be at least a few hold-over cases which will develop afterward. This makes repeated inspection absolutely necessary and such repeated inspections *very* soon cost more than the value of the entire lot of trees. In most cases it will be real economy to pull up the trees and burn them at once.

The speaker, in cooperation with the state authorities, discovered the disease for the first time in the states of New Jersey and Virginia in 1911. In the former case the entire lot was destroyed by the owner, while the action taken in the latter is not known. No fruiting bodies were found in Virginia, but the swollen stems were present in a few cases. During the past year the disease has been shipped to us by a French firm and inquiry showed that they raised their trees themselves.

The finding of the teleuto stage of the fungus affecting the stipule and bracts of a *Ribes* leaf in the greenhouse, is believed to practically prove that the fungus may sometimes attack the bud scales of dormant bushes and cuttings; this very probably explains the anomalous appearance of this fungus in this country upon *Ribes* at Geneva, N. Y., and possibly in Kansas.

The single German nursery of J. Heins's Sons has sent us over 95 per cent. of the total amount of diseased stock that has been found in this country, yet they say they have no disease in their nursery. Barely a month ago the writer received samples of their white pine stock, which had just been submitted to the superintendent of the New York State Forests by Heins's Sons, and one at least had visible swelling of the stem, which the writer is confident is caused by the blister rust. This shows that he was correct in his former suspicion that they do not know the field characters of this disease. Inoculations have been successfully made by the writer with spores from diseased white pine trees sent by J. Heins's Sons to Lake Clear Junction and Salamanca, New York, and to the states of New Jersey and Connecticut, upon *Ribes* in the greenhouse. The shipments thus tested were made in 1908, 1909 and 1910.

Experience with greenhouse inoculations on *Ribes* shows that the teleuto stage develops only after the cool weather of autumn sets in: that is, the uredo stage flourishes through the summer, but the teleuto stage does not appear until cooler weather prevails. The experiments for two years agree in showing this peculiarity. Greenhouse inoculations have been made upon young *Pinus strobus* with teleutospores secured by inoculation on *Ribes americanum* with æcidiospores borne upon imported trees of *Pinus strobus*. Inoculations thus made in November, 1910, are now beginning to give results. One each of the trees inoculated with wounds and without wounds is now showing slight swelling such as is so characteristic of the blister rust disease.

PERLEY SPAULDING
OFFICE OF FOREST PATHOLOGY,
BUREAU OF PLANT INDUSTRY,
U. S. DEPARTMENT OF AGRICULTURE

THE BOTANICAL SOCIETY OF AMERICA

THE annual meeting of the Botanical Society of America was held at the Business High School, Washington, D. C., December 27 to 29, 1911.

The following were elected officers for the ensuing years:

President—L. R. Jones, University of Wisconsin.

Vice-president—B. M. Duggar, Cornell University.

Secretary—G. T. Moore, Washington University.

Councilor—Wm. Trelease, Missouri Botanical Garden.

These, with Arthur Hollick, treasurer, and C. L. Shear and R. A. Harper, councilors, constitute the council for 1912.

The following associate members were elected to full membership: D. H. Campbell, Stanford University; M. L. Fernald, Harvard University; J. B. Overton, University of Wisconsin; P. H. Rolfs, Florida Experiment Station; P. A. Rydberg, New York Botanical Garden.

Botanists elected to associate membership were: I. W. Bailey, Harvard University; F. S. Collins, Malden, Mass.; C. W. Edgerton, Louisiana Experiment Station; J. H. Faul, University of Toronto; R. McM. Harper, University of Alabama; H. Hasselbring, Bureau of Plant Industry; C. E.

Lewis, Maine Experiment Station; F. Ramaley, University of Colorado; D. Reddick, Cornell University; Frances G. Smith, Smith College; A. Stewart, University of Wisconsin; H. N. Whitford, Bureau of Forestry, Manila; F. D. Wolf, Alabama Experiment Station.

The address of retiring President Erwin F. Smith on "Some Aspects of the Relationship of the Crown-gall Disease to Human Cancer" and the symposium on "Modern Aspects of Paleobotany," participated in by F. H. Knowlton, John M. Coulter, Edward C. Jeffrey and Arthur Hollick, will be published and distributed to the members of the society.

The dinner for all botanists was held Thursday night. Mr. David Fairchild was toastmaster and a number of botanists spoke briefly upon the particular aspect of work in which they were interested.

The smoker given by the members of the Washington Botanical Society to all visiting botanists, on Friday night, was largely attended and a most enjoyable affair.

Following are abstracts of papers presented at the symposium on "Modern Aspects of Paleobotany":

I. *The Relations of Paleobotany to Geology:* F. H. KNOWLTON.

The present paper emphasizes the fact that paleobotany, in common with all the other branches of paleontology, admits of subdivision into two lines or fields of study—the biological and the geological—depending upon the prominence given to the one or the other of these phases of the subject. As the biological side is to be handled by other contributors to this discussion, the present contribution is, naturally, confined to the geological aspects of the science. It is shown that fossil plants afford a series of stratigraphic marks, serving for the identification of geological horizons, that are unsurpassed in value by those afforded by any of the many other branches of paleontology; and nowhere in the world is this fact so thoroughly recognized and accepted as in North America. Objection is frequently made, especially by botanists, that impressions of plants, the form in which they are most utilized by geologists, are often of doubtful biologic value. In reply to this it is shown that while the paleobotanist uses his utmost endeavor correctly to fix the biologic status of the material he uses, it makes not the slightest difference to the stratigraphic geologist whether the fossils upon which he most relies are correctly named, biologically, so long as their horizon is known and they are clearly defined and capable of recognition under any and all conditions. The various phases of this aspect of paleobotany are set forth in detail, especially in its general geological and economic applications. The value of paleobotany in the interpretation of geological climate is also treated at some length.

II. *The Relations of Paleobotany to Botany.*

1. *Phylogeny and Taxonomy:* JOHN M. COULTER.

It is impossible to disentangle morphology and phylogeny, for the largest motive in modern morphology is to construct phylogenies. An excessive amount of overlapping will be avoided in this paper by laying the emphasis upon the inferences to be drawn from morphological investigations as to probable lines of descent, rather than upon the morphological results themselves.

As a result of the recently developed paleobotanical connections, the phylogeny of the vascular groups can be made now a resultant of comparative structures and actual history. Many an old phylogeny, based upon the comparative structures of existing plants alone, has been contradicted by history, which, in the nature of things, must furnish the final check upon any proposed phylogeny.

The title of this paper includes the taxonomy, but in so far as this deals with great groups, defined or discovered, it is covered by the statements concerning phylogeny. So far as it deals with the recognition of individual forms, it is clear that paleobotany must learn to recognize the relationships of fossil plants, or there will be no reliable taxonomy or phylogeny. So long as paleobotany depended upon the form resemblances of detached organs, there could be no taxonomy in the real sense. It was merely a cataloguing of plant material. But when it learned to uncover structure, it began to establish a real taxonomy. The contributions of paleobotany to taxonomy, therefore, may be summed up in the statement that it has begun to extend our schemes of classification into the ancient floras; that this has resulted in a far truer view of the great groups than their expression in the present flora can possibly give; and that this makes a rational phylogeny possible.

Illustrations are given of the great changes of view, brought about by paleobotany, that have occurred during the last decade. The illustrations are taken from the Lycopodiales (*Lycopodium, Selaginella, Isoetes*), showing the present opinion

as to the relation between the paleozoic and the present representatives; from Equisetales, showing the recent development of knowledge in reference to the paleozoic forms; from Filicales, showing the disappearance of the paleozoic assemblage once called ferns, and the development of knowledge in reference to Palæo-Marattiaceæ and Prinofilices; and especially from Gymnosperms, showing the remarkable reconstruction of the phylogeny of that group.

The great problem of paleobotany to-day is the history of angiosperms. Having perfected a weapon in the attack upon gymnosperms, it remains for the paleobotanist who is a vascular anatomist to uncover the origin of our greatest group, with its comparatively brief history. The origin is probably recorded in the Mesozoic, and we wish to see the significant structures, and not guess at external form, and much less guess at purely hypothetical connections. To this great task paleobotany is turning. We have had the guesses; and I am confident that presently we will have the facts.

2. *Morphology:* EDWARD C. JEFFREY.

The often perfect condition of preservation of plant fossils and the comparatively unbroken series, which they present, from the remotest times to the present, has been of the greatest importance for the modern development of plant morphology. It is now clearly recognized that the doctrine of recapitulation, far from being solely exemplified by zoologic types, is much more clearly and certainly deducible from the historical and developmental study of plants, which in this as in so many other respects, show themselves more advantageous for evolutionary studies than animals. It is clear likewise from the studies of the past decade, or decade and a half, that external morphology, even that of the reproductive organs, is of comparatively slight importance in connection with the doctrine of descent or its practical application to the natural system. Applied to the internal structures, the doctrine of recapitulation has many and striking illustrations in plants living and extinct. The correlation of paleobotany with internal morphology has shown, moreover, that the investigation of reversions is a very profitable direction of scientific exploitation. In addition to exemplifying recapitulation and reversion, plants further present another law, which is for the most part not apparent in animals. It has been shown, namely, that of the separate organs of the plant, the stem is most progressive and that root and leaf lag behind in evolutionary development. As a consequence it is often possible to discover the structures of a remote geologic past in the roots or leaves of plants now living. In the principles of the recapitulation, reversion and retention of ancestral characters, we have as it were the three fundamental R's of morphological science, by the aid of which we are now for the first time in the position to begin the construction of a natural system.

3. *Ecology:* ARTHUR HOLLICK.

Plant ecology is that branch of botany which comprises the study of the interrelations of plants and their relations to environment. As a distinct science it is practically a product of the present generation, and the term has only been recognized in common usage within the past twenty-five years or so.

The relation of paleobotany to botany, in connection with ecology, is mostly concerned with the problems of phytogeography. Paleobotany has supplied the explanations of many puzzling facts in regard to endemic floras; the occurrence of some genus or species only in certain widely separated regions of the earth, and the geographic isolation or limitation of others. Most of the phenomena of plant distribution in general at the present time would have no logical or adequate explanation but for the facts which have been revealed by the study of fossil plants and their distribution in the past.

Among the many striking instances in such connection may be mentioned the explanations which paleobotany has given in regard to the endemic floras of Australia and other regions; the distribution of such genera as *Nelumbo* and *Liriodendron;* and the geographic isolation of *Sequoia, Taxodium, Ginkgo* and other genera.

In tracing the facts of the ancestry, former distribution and extinction of species and genera paleobotany has demonstrated that there is no necessity for invoking the aid of inadequate and unsatisfactory theories of migration in recent times, or the origin of a genus, *de novo,* in two widely separated regions, in order to account for some of the puzzling phenomena of modern phytogeography.

Following are abstracts of the papers presented at the scientific sessions:

The Connective between Conidia of Penicillium: CHARLES THOM, U. S. Department of Agriculture.

References to a "connective" (Brücke, Dis-

junktor, Zwischen-zelle) between the conidia in species of *Penicillium* are widely scattered through the literature. This was figured by Strasburger in "Zellbildung und Zelltheilung" (1879) and reappears in the latest discussion of the group by Westling (1911). The appearances described under these names are easily seen and commonly but by no means uniformly found in certain species. To discuss this the usual method of conidial formation must be briefly described. The spore-bearing cell (sterigma, basidium, conidiiferous cell) has a definite permanent length of fairly uniform diameter, then tapers into a tube of smaller diameter from which the conidia are abstracted. This fertile tube elongates rapidly during the growing period. The nucleus of the cell divides, one daughter nucleus migrates to the tip of the tube, a wall then cuts the new cell from the old. The newly formed conidium in every species so far carefully studied is cylindrical, and more or less quickly swells to assume the globose or elliptical form characteristic of the particular species. The cylindrical form is lost so quickly that many preparations will not show such conidia, especially where growth conditions are not especially favorable. Similarly the tube may be very short or 2 to 3 μ in length in the same preparation. As the conidia swell from the cylindrical to the elliptical or globose form the appearance described as a connective is obtained when the primary wall of the original tube fails to follow the change in form and leaves an open space between itself and the new walls of the adjacent conidia in the chain. This appearance is by no means uniform in any species examined, but admits of the same explanation in every case seen. Nuclei have been fixed and stained in but few of these forms.

Perennial Gametophytic and Sporophytic Generations in Puccinia obtegens (Lk.) Tul.: EDGAR W. OLIVE, South Dakota State College of Agriculture and Mechanic Arts.

This brachyform of rust, better known under the name of *P. suaveolens,* grows at Brookings on an European variety of Canada thistle. As described by Rostrup and others, it is said to possess two distinct generations: one resulting from a general infection throughout the whole plant, in which the characteristic, sweet-smelling pycnidia are shortly followed by large, confluent sori of uredospores, among which are later developed a few teleutospores; and, second, a strictly local infection, in which only uredo- and teleutospores are produced and borne in small, scattered sori.

Some preliminary cytological investigations of the so-called first generation show that both uninucleated gametophytic and binucleated sporophytic mycelia ramify together throughout the infected plants. The uninucleated mycelium produces the pycnidia; and is present also at the base of the uredo-sori. But the binucleated mycelium also invades the uredo-sori and these sporophytic hyphæ alone apparently produce the uredospores, which therefore should be regarded as secondary in their nature. Primary uredospores, produced by sexual fusions, were not observed. Teleutospores also arose from the same sporophytic mycelium.

The general infection of the Canada thistle is therefore due to the growth of two generations: a mixture of gametophytic as well as sporophytic mycelia; and the evidence appears to show further that both uninucleate and binucleate mycelia winter-over together in this mingled state in the underground parts of the plant.

A Revision of the North American Species of Puccina on Carex: FRANK D. KERN and MARY A. FITCH, Purdue University.

Although there has been an accumulation of considerable information concerning the North American sedge rusts most mycologists have regarded this group as especially difficult. This is perhaps due to the fact that the telia do not usually present diagnostic characters. In the separation of these species it has been necessary to look for other features, and, as has been the case in several other groups of the rusts, it has been found that the urediniospores have furnished especially good characters. The æcial connections as brought to light by cultures are also important. The presence of amphispores in some of these species and the splitting of other species into races lend biological interest to these studies. About twenty-five species of *Puccinia* on *Carex* can be recognized in North America, the majority being endemic. About three fifths of these have had their life-histories worked out.

Cultures of Uredineæ in 1911: J. C. ARTHUR, Purdue University.

The thirteenth year of culture work with plant rusts gave an unusual number of failures, largely ascribable to the unseasonable hot weather. Of the 193 available collections with resting spores, mostly on grasses and sedges, only 37 germinated, as proved by about 700 drop-culture tests. Out of the small number 14 infections were obtained, with 143 sowings. In addition to these 17 infections

were obtained from freshly gathered material of *Gymnosporangium*, *Peridermium* and *Æcidium*, out of 91 sowings.

The most important results of the year were (1) finding an æcial host for *Gymnosporangium speciosum* outside of the families Malaceæ and Rosaceæ, *i. e.*, on *Philadelphus*, belonging to the family Hydrangiaceæ, and (2) finding that both the *Uromyces* and *Puccinia* on *Distichlis spicata* produce indistinguishable æcia on the same æcial hosts. The latter result taken in connection with facts brought out in former culture work leads to the conclusion that in some cases at least forms placed in the two genera, *Uromyces* and *Puccinia*, are not worthy of generic difference, and scarcely entitled to specific difference. They more truly represent races, or possibly varieties, of one species, rather than two species belonging to two genera.

Plus and Minus Strains in an Ascomycete: C. W. EDGERTON, Louisiana Experiment Station.

A species of *Glomerella* collected on a petiole of a cottonwood leaf in Louisiana has been producing perithecia on culture media for nearly a year and a half. The original culture has been separated into two distinct strains, called Plus and Minus. The Plus strain develops mature perithecia in masses occasionally, these being identical with other species of *Glomerella*. The Minus strain develops the perithecia singly or in two's or three's over and in the medium, but these do not come to maturity except on certain media and then the asci are very ill-shaped. When the two strains are grown on the same plate, there is a boundary line, where they come in contact, of well-developed perithecia. There is a cross-fertilization between the two strains, as is shown by the fact that ascospores in the same perithecium develop both strains on culturing.

The Morphology of Zygorhyncus and its Relation to the Ascomycetes: GEO. F. ATKINSON, Cornell University.

In *Zygorhyncus* the fruiting hyphæ are aerial and arise from the submersed vegetative mycelium. The branching is sympodial, the first sporangium terminating the primary hypha, the system finally bearing several sporangia, the successive ones usually standing higher. The sporangial branches are often more or less spirally curved.

The branched gametophore is the morphological equivalent of the sporangiophore, and the sexual branches are morphologically equivalent to the sporangial branches, and arise according to the same plan. The gametophores and sporangiophores are usually pure, but sometimes mixed.

The first antheridial branch is terminal, and subtended by the oogonial branch. The latter curves around, is often spirally twisted, and comes in contact with the former, usually touching it on the side. The end of the oogonial branch then enlarges into an oval body and is divided by two cross walls. The terminal pointed cell in contact with the antheridium is the homologue of the ascomycete trichogyne, and the subterminal cell is the egg. The "zygospore" wall eventually includes the two cells.

The sexual apparatus of *Zygorhyncus* is of the same type, and may be regarded as representing the ancestral form of the same, in *Monascus*, *Gymnoascus*, *Pyronema*, etc., and the gametophore may be regarded as representing the ancestral form of the Laboulbeniales. It does not seem necessary, therefore, to derive the ascomycete thrichogyne from the Rhodophyceæ.

Development and Fertilization in Olpidiopsis: J. F. BARRETT, University of Illinois.

Three species of *Olpidiopsis* were included in this study: *O. Saprolegniæ* Cornu, on *Saprolegnia*; *O. vexans* nov. sp., on *Saprolegnia*, and *O. luxurians* nov. sp., on *Aphanomyces*.

Zoospores biciliate with the cilia of equal length and attached at or near the anterior end of the elongated body. Zoospores possess two motile stages separated by a brief period of rest, suggesting a primitive type of diplanetism. Individuality of the zoospore, after penetrating the host, is maintained throughout its development. Little if any amœboid movement.

Segmentation of the sporangial contents apparently simultaneous throughout. Zoospores on escaping contain vacuoles.

True sexuality probably exists, and takes place by the fusion of two sexually differentiated individuals and the subsequent passage of the protoplasm of the smaller, male, into the larger, female, cell. This is followed by a supposed fusion of nuclei.

Both sexual and asexual reproductive bodies develop rather rapidly from a uninucleate to a multinucleate condition. The oospore is likewise multinucleate.

External conditions play a great part in the determination of sex in these organisms. This fact adds evidence, it seems, to the doctrine that sex in many plants is determinable by external or nutritive conditions.

Nuclear division is mitotic with the nuclear spindle intranuclear.

Variations in Glomerella: C. L. SHEAR, U. S. Department of Agriculture.

The results are given of studies of various races, strains, varieties and species from forty-six different host plants. Variations in morphological characters of all kinds were observed. Great variations in physiological characters, such as virility, adaptability to various hosts and reaction to culture media, also occurred.

Numerous generations started from single ascospores and conidia were grown under the same conditions. Rather striking and sudden variations occurred in some of these cultures, also intergrading forms and variations appeared. The conidial generations showed greater variation than the ascospore generation. Most of the variations studied show no direct relation to the culture media or other conditions of environment. More or less distinct races or strains were found to occur on the same host. These strains maintained their principal characteristics in cultures as long as they were grown.

The Perfect Stage of the Rose Actinonema: F. A. WOLF, Alabama Experiment Station.

The fruit bodies of *Actinonema rosæ* are not pycnidia as in the Sphæropsidales, but acervuli as in the Melanconiales. Persoon, who described the genus *Actinonema* ("Mycol. Eur.," 1822) characterized it as having radiate, sterile, mycelial strands. Fries ("Summa veg. Scand.," 1849), whose characterizations Saccardo employs, describes the genus as having a fibrillose radiating mycelium, a delicate perithecium and bilocular spores. The genus *Marsonia,* whose conidia are similar to *Actinonema,* has a *subepidermal* acervulus. The acervulus of *Actinonema rosæ* is *subcuticular.* The rose fungus evidently possesses the characters of neither a typical *Marsonia* nor of an *Actinonema.*

Leaves affected with the conidial stage, when wintered out-of-doors, developed a microthyriaceous ascosporic stage. The shield and spores are like *Asterella.* These perithecia though consist of a *subcuticular* shield and an innate apothecium which are entirely separate in origin and open like the Phæcidiales. The Microthyriaceæ are *superficial* and with a well-developed structure *only on the upper side.* The type of development as exhibited in the rose fungus is not like *Asterella,* which has been made to include heterogeneous elements and so a new generic name, *Diplocarpon,* is proposed. This study connects for the first time the conidial and ascosporic stages of the organism causing the black spot of roses. The new name *Diplocarpon rosæ* is given to the fungus.

Infection Experiments with the Powdery Mildew of Wheat: GEORGE M. REED, University of Missouri.

Experiments have been made in which eighty different varieties, belonging to nine different species of *Triticum,* were inoculated with conidia of *Erysiphe graminis* DC. occurring on wheat. By far the larger number of these varieties proved entirely susceptible to the fungus. Forty-eight varieties gave an infection of 100 per cent.; seventeen, an infection of 70 per cent. or higher; four, an infection of 50 to 70 per cent.; four, a low percentage of infection (4 to 27 per cent.); and seven proved practically immune to the mildew. In the case of some of the latter varieties an occasional partial infection was noted.

The seven immune varieties found belonged to two species (*Triticum dicoccum* and *Triticum vulgare*), five of these varieties belonging to the former and two to the latter species. The emmers, as a group, have proved to be quite free from infection, although some, as the Winter Emmer and Red Emmer, were entirely susceptible. It was noted that in every case the varieties which proved to be highly resistant to infection are spring varieties.

No one of the nine species of *Triticum* tested proved to be entirely immune. In every case one or more varieties belonging to each of the species gave infection.

The Organization of the Hymenium of the Hymenomycetes: A. H. REGINALD BULLER, University of Manitoba.

The Nature and Proper Treatment of Lichens: BRUCE FINK, Miami University.

An outline of the discussion to appear in the second paper of the series on "The Nature and Classification of Lichens" now being published in *Mycologia.* A statement of the difficulties due to the traditions regarding lichens and the consequent inconsistent treatment of lichens by many botanists. A brief outline of the arguments for or against various ideas and hypotheses, especially those of de Bary, Schwendener, Reinke, Schneider, Peirce, Danilov, Elenkin, Famintzin, Bessey and Clements. A conclusion reached as to whether the lichen is a colony, a dual organism or a fungus. In conclusion, the fundamental problems regarding the proper treatment of lichens by morphologists,

taxonomists, physiologists and ecologists are discussed briefly.

The Deposition of Iron on the Mycelium of an Aquatic Fungus: GEORGE T. MOORE, Washington University.

An aquatic ascomycete having peculiar spine-bearing spores, which readily germinate, was described. The mycelium from the germinating spores soon becomes encrusted with iron in much the same way that the so-called "iron bacteria" are covered with a deposit of iron. The material was particularly favorable for demonstrating that the process of iron deposition was not a vital one, as has been supposed for the bacteria.

A New Wood-penetrating Alga: GEORGE T. MOORE, Washington University.

An unbranched filamentous alga, with affinities with the Cladophoraceæ was found penetrating the cells of a yellow pine board, which had been submerged in an aquarium for several years. The germination of the akinetes and peculiar habit of growth was described.

The Structure and Development of the Colony in Gonium: R. A. HARPER, Columbia University.

The 16-celled colonies of *Gonium* are formed from the mother-cell by definite mosaic development and are thus in sharp contrast with the colonies of *Hydrodictyon* or *Dictyostelium*. The mother-cell divides by three successive bi-partitions, the successive planes of division cutting each other at right angles. Each cell of the daughter colony occupies the same position in relation to its sister cells as it had in the undivided protoplasm of the mother-cell. The plane of the first division is apparently determined within the cell. The different cells of a mother colony divide at all angles with the plane of the colony as a whole. The changes of position and form which the cells of the daughter colonies undergo as they grow to mature size are apparently determined entirely by relations of adhesion, surface tension, etc. Only qualities of the cells as such appear to be transmitted; the organization of the colony as a whole is only indirectly represented in the mother-cell.

Some Physiological Conditions in the Culture of Spirogyra: W. D. HOYT, Rutgers College.

A large part of the trouble commonly experienced in growing algæ in the laboratory is probably due to the water used, since, in physiologically pure water, *Spirogyra* was kept in perfect condition for several months. The nutrient solutions of Sachs, Molisch, Knop and Crone were tried. The best growth was obtained in Crone's solution containing from 0.05 per cent. to 0.1 per cent. of total salts.

As has been shown by others, tap water and ordinary distilled water were highly toxic. The contained toxic substances were partially or wholly counteracted or removed by the addition of some, but not all, absorbing substances; by a high concentration of nutrient salts—0.5 per cent. to 1 per cent. of total salts; or by great heat. The results obtained indicate that the toxic bodies of tap water and distilled water were different substances; that those of tap water were, in part, volatile organic substances; and that those of distilled water were largely non-volatile inorganic substances.

A good growth was obtained only when a properly balanced solution containing all the nutrient salts was used, but the salts of any two of these metals gave a better growth than the salt of any one metal when used alone. No specific antagonistic action was observed—a mixture of magnesium and potassium salts seemed just as favorable as a mixture of magnesium and calcium salts.

A colloidal solution of silver was fatal in all concentrations as low as 0.0000045 per cent. and was injurious in concentrations as low as 0.000000225 per cent. The addition to the weaker silver solutions of a 0.05 per cent. concentration of Crone's solution or of animal carbon produced marked improvement in the solutions. A colloidal solution of gold was only slightly injurious at a concentration of 0.009 per cent., while a colloidal solution of platinum of a .0096 per cent. concentration was not only not injurious during a short time, but produced improvement in tap water, in a weak colloidal silver solution, and in a solution of magnesium sulphate.

When filaments of *Spirogyra* were placed in colloidal gold or platinum, to which was added about 0.015 per cent. NaOH, the outer layers of their walls swelled and formed gelatinous-looking sheaths which often broke off in crumpled masses. These sheaths were not formed in either the platinum solution alone or in the NaOH solution alone, but were formed when both NaOH and either gold or platinum were present. These sheaths were deeply colored by the gold and platinum, while the layers of the wall which formed no sheaths remained uncolored.

The Effect of Light on the Liberation of the Eggs and Spores of Dictyota dichotoma: W. D. HOYT, Rutgers College.

As the eggs of *Dictyota dichotoma* approach maturity, two layers can be distinguished in the walls of the oogonia, of which the inner becomes very thick as the egg ripens. In the discharge of the egg, the outer wall is burst, while the inner, still enclosing the egg, is protruded and is soon dissolved, freeing the egg and allowing it to round up. The outer layer of the oogonium wall then appears as a ruptured, crumpled membrane.

The discharge of the tetraspores was not observed, but probably occurs by the same mechanism since the young, mature and empty walls of the tetraspore mother cells show the same appearances as those described for the eggs.

Both at Naples and at Beaufort, North Carolina, the discharge of eggs in the laboratory began very early in the morning, when daylight was just visible or even, at times, before the slightest trace of light was discernible. At Beaufort, the time when this discharge commenced varied in different summers, and in the latter part of any one summer, but was fairly constant for the earlier months of each summer. Both at Beaufort and at Naples, about 70–80 per cent. of the eggs liberated in any one day were discharged within the first half hour and about 80–90 per cent. were discharged within the first hour. At Beaufort about 70–80 per cent. of the entire crop of eggs were thus liberated within a single hour of one day of each month.

Attempts to alter the time of the discharge by subjecting the plant to various conditions of light and darkness were effective only as they affected the healthy condition of the plant. The attempt to induce liberation at other times of the day by exposure to various degrees of light, or to alternating darkness and light, was entirely without success. Discharge occurred as abundantly in dishes covered with red and with blue glass as in dishes covered with white glass.

The tetraspores were liberated throughout the day, although the majority were discharged before 7:00 A.M. Attempts to alter their rate of discharge by exposure to various conditions of light and darkness gave no marked result.

The experiments indicate that the light rays affect the liberation of eggs and spores by their effect on the well-being of the plants, rather than by acting as a direct stimulus to the discharge of these cells.

Alternation of Generations in certain Florideæ: I. F. Lewis, Randolph-Macon College.

Species of several genera of Florideæ have been cultivated during the past two summers at Woods Hole. By using the method employed by Hoyt with *Dictyota* it has been found possible to rear to maturity sporelings of known origin. In this way it has been shown that in *Griffithsia Bornetiana* and in *Dasya elegans* tetraspores without exception gave rise to sexual plants, which in *Dasya* were mostly male, and in *Griffithsia* about half male and half female. In *Polysiphonia violacea* carpospores produced, also without exception, tetrasporic plants. Hundreds of cases were observed. The experiments cited may be regarded as proof of the assumption, on cytological grounds, that there is an alternation of sexual and asexual individuals in Florideæ producing both tetraspores and carpospores.

The Germination of the Spore of Nemalion multifidum: I. F. Lewis, Randolph-Macon College.

After being shed, and attaching themselves to some hard substratum, the spores of *Nemalion* remain without visible change save a slight increase in size for twelve to twenty-four hours. The center of the spore is occupied by the large chromatophore with its pyrenoid, the latter bearing a marked resemblance to a nucleus, but larger. The small nucleus lies to one side of the pyrenoid. The first sign of germination is the protrusion of a germ tube through the spore wall. Into this the pyrenoid passes, along with most of the protoplasm. The spore cavity is left nearly empty. The nucleus, lying at the base of the germ tube, divides in the manner described by Wolfe for the nuclei of vegetative cells. One of the resulting daughter nuclei passes into the germ tube, the other into the spore cavity, where it becomes closely appressed to the wall as a structureless mass. The number of chromosomes in the first and later divisions is probably 8. A cross wall separates the germ tube from the nearly empty spore body, the latter taking no further part in development and soon dissolving in the sea water. The germ tube continues to elongate, and its nucleus divides in the usual way. The pyrenoid divides at about the same time, and a second cross wall cuts the germ tube into two parts, each with nucleus, chromatophore and cytoplasm. The apical cell so formed grows in length and divides. Repetition of this process results in the formation of a monosiphonous filament.

Nuclear Division in Spirogyra setiformis: F. McAllister.

The first indication of nuclear division is the accumulation of protoplasm at the poles of the nucleus. Later the nucleole loses its regular outline and stainable material seems to be given off from it into the nuclear cavity. No spirem seems to be formed from the reticulum. When the nucleole is nearly or wholly disintegrated, fibers from the polar region enter the nucleus and at the same time all the stainable material contracts to form the equatorial plate. This now separates into two parts, which move to the poles as dense homogeneous masses. Vacuoles appear and ultimately the stainable material is uniformly distributed through the daughter nucleus as pale blue-staining bodies. Red-staining bodies appear. The blue-staining bodies lose their distinctness and part of them, at least, form a homogeneous blue-staining ground substance in which the several red, nucleole-like bodies are imbedded. This mass rounds up to form the nucleole of the resting nucleus. During nucleole formation a delicate reticulum has appeared.

The Effect of Gymnosporangium upon the Transpiration and Photosynthesis of Apple Leaves: HOWARD S. REED and J. S. COOLEY, Virginia Agricultural Experiment Station.

In connection with pathological studies, the authors made determinations upon water elimination and carbon-dioxide consumption of healthy and rusted apple leaves. The varieties of apple known as York Imperial and Ben Davis were used. Transpiration was measured on twigs on the trees and determined in grams per square centimeter per hour. An average of five tests on Ben Davis apple leaves showed that in rusted leaves the water elimination was 50 per cent. of that in healthy leaves on the same trees.

For determining the rate of photosynthesis Ganong's photosynthometers were used. Experiments were always run in duplicate, using healthy and diseased leaves. Results were expressed as cubic centimeters of CO_2 consumed per square centimeter per hour. The diseased leaves showed marked diminution in power to consume CO_2.

A Study of Protoplasmic Movements in Fungi: F. M. ANDREWS, Indiana University.

Very little work has been done on the subject of protoplasmic movements in fungi. This study was undertaken in Pfeffer's laboratory to ascertain if the few observations made were correct and to extend them.

The fungi used for this investigation were *Mucor stolonifer, M. mucedo* and *Phycomyces nitens.* They were grown in various nutrient media such as a 4 per cent. solution of cane sugar; in gelatine (generally 10 per cent.), plum juice and others.

In making these investigations it was first attempted to determine the nature of the protoplasmic movements in the fungal filaments as they occur under ordinary conditions. Secondly it was desired to ascertain the effect of external conditions in the streaming movements such as temperature, food, transpiration, osmosis, light, injury, etc.

The most favorable temperature for growth is from 23 degrees to 26 degrees for the plants used. Below the optimum sudden rise in temperature of a few degrees results in movement if the protoplasm is still or an acceleration where slow movement is already present if all the other conditions are perfect.

In most cases those nutrient media containing sugar of sufficient strength produced an active growth and filaments having a large diameter which was necessary for favorable study. The gelatine and plum juice media also produced actively growing and wide filaments. In some other media, as where the sugar was entirely absent, only feeble narrow filaments were found.

In actively streaming specimens dry air caused acceleration for a time and then cessation of movement. On using moist air immediately after movement recommenced.

Streaming can also be produced in the filaments of these plants by placing a solution of sugar about the filament. Streaming then begins and continues according to the strength of the solution for some time. If after stoppage of the movement fresh water is added, the movement recommences.

Light, while not so noticeable as the other factors mentioned, causes a slight acceleration of movement of the protoplasm after the plant has been darkened for a considerable time.

Also injury, if not too severe, may cause movements to begin. All the conditions here mentioned have no effect unless the protoplasm is in a condition for streaming.

A Method for Preparing Stained Cells in Toto for the Study of Karyokinesis: ALBERT MANN, U. S. Department of Agriculture.

A Comparison of the Somatic and the Reduction Divisions in Carex aquatilis: A. B. STOUT, New York Botanical Garden.

In *Carex aquatilis* the chromosomes can be identified as individuals in the resting nuclei in

root tips, tapetum and sporogenous tissue and they can be traced as separate individuals throughout the whole process of somatic cell division. They also maintain a serial order in which the chromosomes appear as individual spheroidal masses with a relative place relationship. This is most clearly in evidence during the prophases.

In the prophases of the reduction division, on the other hand, the chromosomes appear at synapsis as an extremely thin double thread which in the thick spirem stage again appears single. This is in marked contrast to the somatic prophases where the chromosomes maintain a separate individuality which can be traced. In the preparation for the reduction division the substance is spun out and the chromosomes are so closely connected end to end that they can not be identified as individual units. It would appear that in this condition the opportunity is given for mutual influence and exchange of substance between homologous pairs.

After the reduction division occurs the three nuclei which lie at the apex of the wedge-shaped spore mother cell divide, making six nuclei which then die and become flattened out against the wall. The wall of the spore mother cell functions as the wall of the microspore.

In the resting nuclei of the microspores the chromosomes appear again as separate individuals.

Precarious Tests for Chemotropism of Roots: F. C. Newcombe, University of Michigan.

There is probably no part of a plant so sensitive to so many external stimuli as the tip of the root. The root-tip will give tropic responses to gravitation, in many plants to light, to moisture, heat, chemicals, in many species to pressure, to wounds.

The author has found still another response—that to a water-imbibed body in a water-saturated atmosphere. A piece of wet filter paper or of unglazed porcelain attached to the sloping side of the root will call forth a negative curve even in a water-saturated atmosphere. This result may be due either to a disturbance of hydrostatic conditions within the cells of the root, or to the accumulation in the attached body of volatile excretions of the root. The possible excretions must be volatile; for repeated use on successive roots of the same bits of paper, without washing, leads to no greater response. Either of the two possibilities assumed above could be interpreted as effecting traumatropic curves.

This extreme sensitiveness of the root-tip shows how precarious are the results of authors who think to test the chemotropism of roots by applying to the tip bits of paper imbibed with chemicals.

The Nature of the Absorption and Tolerance of Plants in Bogs: Alfred Dachnowski, Ohio State University.

The considerations of the quantitative nature of habitat factors, which are rightfully desired as a basis for a theory of physiologically arid habitats, do not, however, render more clearly the nature of the absorption of plants in bogs and the nature of their tolerance to toxic substances in peat soils. The physico-chemical effects of toxic bodies are in part these: they reduce the available water content, and they act in varying degree directly upon the roots of plants and their functions. Since there are (under field and laboratory conditions) no differences in the evaporating power of the air, in temperature, in greater intensity of light, in the gradient of osmotic concentrations and in the possible rate of movement of water through the soil; and since no morphological limitations in the absorption and in the conduction of water (in the agricultural plants used) enter into the problem, the phenomena of absorption and of resistance to desiccation deal, plainly, with considerations of the permeability of the absorbing protoplasmic membrane, its power of endurance and its ability to transform the injurious bodies into insoluble, impermeable compounds. A study of the behavior of different species of cultivated plants and especially a number of their varieties forces the assumption that changes of a cytoplasmic nature are particularly important under the conditions of growth.

The Permeability of Protoplasm to Ions and the Theory of Antagonism: W. J. V. Osterhout, Harvard University.

Experiments were performed to test the electrical conductivity of living tissues in various solutions. The results show conclusively that a great variety of ions readily penetrate living cells and that antagonism between salts may be explained by the fact that they hinder or prevent each other from entering the protoplasm. The ions of NaCl readily penetrate the protoplasm, but the addition of a small quantity of $CaCl_2$ greatly hinders this penetration. Such salts as KCl, $MgCl_2$, CsCl, RbCl, LiCl, NH_4Cl, NaBr, NaI, $NaNO_3$, Na_2SO_4 and Na-acetate act in general like NaCl while $BaCl_2$ and $SrCl_2$ act like $CaCl_2$.

The mechanism of this action is not fully under-

stood, but it may be stated that $CaCl_2$, $BaCl_2$ and $SrCl_2$ bring about visible changes in the plasma membrane which are quite different from those produced by such salts as NaCl, and it is hoped that a further study of these visible changes may throw some light on this question.

Observations on Evaporation and Transpiration in Prairie and Forest: B. SHIMEK, Iowa State University.

In an effort to determine the differences between forest and prairie plants which would account for their distribution, observations were made on the transpiration of certain forest and prairie plants in their native habitats and in transposed habitats. To illustrate the plan and purpose of the work two sets of plants are taken. In one of these cases *Phryma leptostachya* L. from the forest and *Kuhnia eupatoroides* var. *corymbulosa* T. & G. from the prairie were compared, and in the other *Anemone virginiana* L. from the forest and *Verbena stricta* Vent. from the prairie were employed for the same purpose.

Two stations were selected on a ridge near Iowa City, one side of which is prairie and the other forest, one station being located in each. The plants, which were as nearly as possible equal in size and vigor, were cut and inserted into bottles of water, which were sealed. Two plants, one from the forest and one from the prairie, were placed at each station, and the loss of water was determined at two-hour intervals.

In addition to this, observations were made at each of the stations on evaporation, and the meteorological conditions affecting it. The latter observations showed substantially the same relative results for prairie and forest as those previously published by the writer.

The results may be briefly summarized as follows:

The *Phryma* in the forest lost 1.9 gram, while that on the prairie lost 4.65 grams. The latter transpired very actively until it began to wilt, and then transpiration declined very rapidly, the plant soon becoming dry and crisp. The *Phryma* in the woods scarcely showed signs of wilting.

The *Kuhnia* in the forest lost 7.16 grams and remained perfectly fresh. That on the prairie lost 11.13 grams, and was also fresh at the close of the experiment. The diminution in transpiration in the forest was probably due in part to diminished activity on account of less intense light.

The *Anemone* lost 3 grams in the woods and 4.89 grams on the prairie.

The *Verbena* lost 6.58 grams in the woods and 27.4 grams on the prairie, transpiration in the woods declining in mid-day, being greater at both extremes of the day. The decline on the prairie in both cases was uniformly quite rapid. The greatest transpiration occurred in all cases just before wilting began.

The general result shows that transpiration and evaporation are not coincident.

Shade as a Factor Influencing Evaporation: G. P. BURNS, University of Vermont.

There is a general belief among some ecologists that the evaporating power of the air is the most satisfactory summation of the atmospheric factors controlling plant distribution.

In forest nurseries it is the usual practise to grow young pine trees in beds covered with racks whose sides are either wood or heavy paper and whose top is covered with lath. Every other lath is nailed, the free lath being later removed to produce "half-shade."

During the summer a study of the condition in the seed-beds has been carried on. The results as shown by the Livingston atmometer are given below.

Numerous stations were established representing all of the conditions found in nursery practise and in the adjacent forest areas. The control station was located in the nursery in a very large wire cage. The average amounts of daily evaporation from the various stations were as follows: control 45 c.c.; full-shade 19 c.c.; half-shade with solid sides 20 c.c.; half-shade with wire sides 43 c.c.; pine woods 16 c.c. Of these amounts from 17 per cent. to 25 per cent. is lost during the twelve hours 6 P.M.–6 A.M., the remainder during the time between 6 A.M. and 6 P.M.

The data gathered seem to show that the shading of young trees is a matter of evaporation rather than a matter of light, as is generally stated in the literature. The final word, however, must be spoken as a result of experiment.

The Investigation of a Climatic Gradient: FOREST SHREVE, Carnegie Institution.

The Santa Catalina mountains, in southern Arizona, rise from the desert plain at 3,000 feet altitude to a height of 9,100 feet. The lower slopes are characterized by desert vegetation, the middle altitudes by chaparral, the higher by coniferous forest. The influence of slope-exposure is such as to make the vertical limits of these zones and their component plants about 1,000 feet higher on

south-facing than on north-facing slopes. Instrumentation has been carried on at six stations, separated by vertical intervals of 1,000 feet. The data have furnished curves showing the altitudinal change of temperature, rainfall, soil moisture, humidity, evaporation and soil temperature. Mensuration has been carried on to determine the density and volume of the stands of characteristic trees at the different altitudes. Ratios of soil moisture to evaporation have been worked out from the instrumental data, showing the conditions which control the water intake and water loss of plants to be nine times as severe at 3,000 feet as at 8,000. The duration of the most critical season, as respects the water relation, is three times as long at 3,000 feet as at 8,000, making the desert conditions actually twenty-seven times as severe as those of the forested summits. The factors of soil moisture supply and atmospheric aridity, modified by slope-exposure, determine the lower limits of forest and the trees of the chaparral zone. The factors of winter cold, modified by topography through the operation of cold-air drainage, determine the upper limits of the characteristic desert species.

A Possible Mutant of the Sugar Maple: A. F. BLAKESLEE, Connecticut Agricultural College.

A single tree discovered in a roadside row of sugar maples is distinguished from the normal type by its peculiar habit of growth. The limbs are slender and branch profusely to form a close thicket of slender branchlets which end at a uniform distance from the trunk and produce an appearance similar to that of a symmetrical arbor vitæ.

A Balancing Method for Differentiating between Absorption and Transpiration: LYMAN J. BRIGGS and H. L. SHANTZ, U. S. Department of Agriculture.

In this method the potted plant is suspended upon knife-edges in a horizontal position, so that the soil part of the system is on one side of the knife-edge and the plant on the other. The system is balanced by counter-weights, and a center of gravity so adjusted as to secure the required sensibility. As water is lost through transpiration, the soil end of the system becomes lighter and rises in consequence. If the moisture content of the plant has not changed during this process, the system will be restored to its zero position by the addition to the soil centroid of a weight equal to the total loss of water from the plant during the observation period. If the weight which must be added to the soil centroid to balance the system is less than the total loss of weight during the period, then the amount absorbed by the plant has been less than the amount transpired. If the weight required to restore the balance is greater than the loss in weight of the system, then the absorption during the period has exceeded the transpiration.

If the distances of the soil and plant centroids from the axis are known, the difference between transpiration and absorption during any period can be quantitatively determined. The location of the soil centroid can be found by observing the loss of weight, after the plant has been kept for a time under uniform conditions, so that the transpiration is equal to the absorption for the observed period. The plant centroid is determined from measurements of the area and the distance of the leaves from the axis.

This method is also adapted to the determination of the wilting coefficient for plants, which, owing to structural peculiarities, do not wilt when the moisture content of the leaves is reduced.

The Application of Wilting Coefficient Determinations to Field Work in Ecology and Phytogeography: LYMAN J. BRIGGS and H. L. SHANTZ, U. S. Department of Agriculture.

The wilting coefficient is defined as the moisture content of the soil (expressed as a percentage of the dry weight) at the time when the leaves of the plant growing in that soil first undergo a permanent reduction in the moisture content as the result of a deficiency in the soil moisture supply.

The results of 1,300 determinations have shown that species differ only slightly in their wilting coefficients when grown in the *same* soil. The type of soil has a great influence upon the wilting coefficient, which ranges from less than 1 per cent. in sand to over 30 per cent. in the heaviest type of clay. It is therefore evident that soil moisture determinations for the purpose of establishing available moisture in the soil are valueless unless the wilting coefficient of the same sample used in the moisture determination is also known.

The desirability of a rapid determination of the wilting coefficient of samples taken in connection with field work led to an investigation to determine whether it could be computed from physical measurements of the moisture retentivity of the soil. Several methods have been developed, the relationships established being expressed in the following equations:

$$\text{Wilting coefficient} = \frac{\text{Moisture equivalent}}{1.84\ (1 \pm 0.007)}$$

$$\text{Wilting coefficient} = \frac{\text{Hygroscopic coefficient}}{0.68\ (1 \pm 0.018)}$$

$$\text{Wilting coefficient} = \frac{\text{Moisture-holding capacity} - 21}{2.90\ (1 \pm 0.021)}$$

$$\text{Wilting coefficient} = \frac{0.01\ \text{sand} + 0.12\ \text{silt} + 0.57\ \text{clay}}{(1 \pm 0.025)}$$

Inhibiting Factors in Lychnis and Papaver: GEORGE HARRISON SHULL, Carnegie Institution.

A cross between white-flowered and purple-flowered forms of *Lychnis dioica* L. (*Melandrium album* and *M. rubrum*), both from Germany, have given an F_1 predominantly white-flowered, though numerous previous crosses between other white-flowered and purple-flowered strains of this species have invariably produced only purple-flowered offspring in the F_1. The white-flowered form from Germany, in crosses with a "recessive white" American strain, produced in one case a white-flowered F_1, in another case a purple-flowered F_1. In *Papaver Rhœas* white has usually proved to be recessive to colors, but in one instance a cross between deep red and white produced a completely whitish progeny in the F_1, and the same result was also attained in a cross between two deep red parents. The latter experience suggests the existence of two complementary inhibiting factors, *A* and *B*, which have no effect except when coexisting in the same plant.

Inheritance in Capsella: H. HUS, University of Michigan.

Seedlings from a single plant of *Capsella Bursa-pastoris* can be classed in three groups: broad-leaved, narrow-leaved and linear-leaved. These forms occur approximately in the proportion 2:2:1. This proportion, which has been maintained for three generations, may perhaps be looked upon as a simple Mendelian splitting in the F_2 generation, of the *Zea* type, complicated by a defective inheritance ratio. This contention meets with the objection that the linear-leaved form represents a type thus far unreported.

The Origin of the Erect Cells in the Phloem of Abietineæ: M. A. CHRYSLER, University of Maine.

If a medullary ray in such a genus as *Pinus* is traced outward from xylem to phloem, it is well known that the marginal tracheids of the woody part of the ray may be seen to be replaced in the phloem by nucleated cells which are somewhat elongated in the longitudinal direction, the so-called "erect cells" of the ray. From a study of the roots of seedlings it is found that various transitions between these erect cells and sieve-tubes occur. Groups of elongated cells provided with nuclei and sieve-plates are a common feature of the phloem of these young roots, and where such a group meets a medullary ray certain of the elongated cells become applied to the ray and become progressively shorter, forming the erect marginal cells, while the rest of the elongated cells give place to ordinary sieve-tubes. Thus from what may be called *primitive sieve-cells* the sieve-tubes are derived by elongation, and the erect cells of the ray by shortening.

Do the Abietineæ extend to the Carboniferous? R. B. THOMSON and A. E. ALLIN, Toronto University.

The claims for the great geological age of the Abietineæ (see Jeffrey and Chrysler, *Bot. Gaz.*, p. 13, 1906) are based on the occurrence of *Pityoxylon chasense* in the Permian and on the supposed occurrence of *P. Conwentzianum* in the Carboniferous.

P. chasense was described by Penhallow in 1900. The pitting of the tracheids is of the Araucarian or Cordaitean type (1–3 seriate, alternate and hexagonal) and bears not the slightest resemblance to that of *Pityoxylon* as defined by Kraus (one-seriate, or opposite when two-seriate), or to that of an Abietinean form. Penhallow, however, placed this form in the genus *Pityoxylon* because of the occurrence of what he supposed were horizontal resin canals. A careful study of the type material has revealed that they are not resin canals but leaf traces quite comparable to those in certain Cordaiteæ and Araucarineæ. This Permian *Pityoxylon* is, therefore, a true Cordaitean or Araucarian.

Gothan has recently shown that *P. Conwentzianum*, which is commonly attributed to the Carboniferous but whose horizon was never determined, can not be an authentic Carboniferous form.

The geological claim for the great antiquity of the Abietineæ thus fails on critical study of the two forms upon which it is based.

Ingrowing Sprouts of Solanum tuberosum: C. STUART GAGER, Brooklyn Botanic Garden.

The paper described a case in which the sprouts of a large number of potatoes grew into and through the tubers that bore them, ramifying

freely and producing roots and small tubers within the large seed tuber. The potatoes were stored in a dry room lighted with diffuse daylight. Sprouts of one tuber never penetrated an adjacent one. Investigation failed to show the presence of any enzymes by the action of which the channels of the ingrowing sprouts could have been digested, though the epidermis of the sprouts was modified so as to resemble typical glandular epithelium, thus suggesting secretion. There was positive evidence that the sprouts made their way through the tissue by mechanical pressure. Attempts experimentally to produce penetration of tubers by potato sprouts met with success, except that the sprouts were unable to penetrate through the epidermis from the outside. These experiments, in connection with the behavior of the original abnormality, led to the high probability of a reversal of polarity in the shoots. The cause of tuber-formation in general was briefly discussed, as was also the bearing of the ingrowing sprouts on the question of the mode of emergence of lateral roots.

The Gametophytes of the Kauri: ARTHUR J. EAMES, Harvard University.

The microspore contains many supernumerary prothalial nuclei. Its branching tubes penetrate the scale-base and the axis, thence crossing the space to the nucellus which is largely eroded, with portions of the endosperm. The megaspore, developing at first within "spongy-tissue," forms a club-shaped embryo-sac, bearing 6–20 archegonia. A small ephemeral ventral canal nucleus is cut off. Fertilization occurs usually in lower archegonia, the two large male nuclei being shunted from the upper egg-cells by a cap of the megaspore membrane which is thickened rather than thin as in most conifers. The pro-embryo maintains a central position in the archegonium in contrast to the condition in other groups until at least 32 nuclei are formed. Then nuclear enlargement and wall-formation ensue, filling the archegonium. The upper 20 or more cells become suspensors, the central group, consisting of a few cells, the embryo proper, and the basal tier a marked protective cap. The large core of suspensors thrust down the two lower tiers deep into the endosperm, where in further development the cap is pushed aside and degenerates.

The Gametophytes of Australasian Podocarps: EDMUND W. SINNOTT, Harvard University.

The gametophytes and embryo of *Podocarpus Totara, Hallii, nivalis, dacrydioides, spicatus* and *ferrugineus* have been investigated. Observations on the male gametophyte add to previous accounts, but agree in general with them. In the first four species (*Podocarpus* proper) three or four months elapse between the appearance of the megasporangium and the ripening of the fruit, and the development of the endosperm, archegonia, and embryo is much as in the Abietineæ. In all species, even a ventral-canal nucleus is uncommon. There are from eight to sixteen suspensors. The last two species (subgenus *Prumnopitys*) are very distinct. The reproductive process extends over sixteen months. The two very large archegonia are narrowed at the base. The fusion nucleus divides into four as it drops and the eight subsequent basal nuclei are irregularly arranged, as are the sixteen cells which follow them. The young embryo has a "penetrating cap." Both species of the subgenus *Prumnopitys* show a marked resemblance to *Cephalotaxus*, and further investigation promises interesting results as to the relationship of the two genera.

The following list of papers, from members of the society, or members of Section G, to be introduced by members of the Botanical Society of America, were received too late to be included in the printed program and were read by title:

Acidity as a Factor in Plant Ecology: F. V. COVILLE, U. S. Department of Agriculture.

The Cultivation of Trailing Arbutus: F. V. COVILLE, U. S. Department of Agriculture.

Ecology as Applied to the Revegetation of Overgrazed Range Lands: A. W. SAMPSON, U. S. Department of Agriculture.

The Relation of Soil Acidity to Plant Societies: A. W. SAMPSON, U. S. Department of Agriculture.

The Effect of a 2 per cent. Aqueous Solution of Antipyrin on the Cells of the Root-tip of Vicia faba: C. F. HOTTES, University of Illinois.

On the Acidity of Certain Cacti: H. M. RICHARDS, Columbia University.

Conditions Affecting the Production of Lycopin in the Tomato: B. M. DUGGAR, Cornell University.

Senility in Meristematic Tissue: H. M. BENEDICT, University of Cincinnati.

A Botanical Survey of Hartsville, S. C.: W. C. COKER, University of North Carolina.

The Biology of the Lakes of Glacier: M. J. ELROD, University of Montana.

The Cytology of Laboulbenia chartophora: J. H. FAULL, University of Toronto.

GEORGE T. MOORE,
Secretary